CLAIMS

1 - A bidirectional actuator comprising at least a stator structure excited by at least one electric coil, characterized in that it comprises a single movable magnet placed in a primary air gap and in that the stator structure comprises at least one electric coil, and is composed of a first pair of stator poles (1, 2) defining between them a first secondary air gap, for displacement of the single movable magnet (14) relative to a first degree of freedom, and of a second pair of stator poles (3, 4) defining between them a second secondary air gap, for displacement of the single movable magnet (14) relative to a second degree of freedom.

2 - A bidirectional actuator according to claim 1, characterized in that the movable magnet is integral with a yoke (25).

3 - A bidirectional actuator according to claim 1 or 2, characterized in that the stator structure is composed of 4 poles of soft magnetic material, which define therebetween two pairs of secondary air gaps which cross at a central point and in that the primary air gap (10) is planar.

4 - A bidirectional actuator according to claim 3, characterized in that the stator poles comprise 4 rectangular pieces, each wound by an electric coil, and defining between them two pairs of perpendicular secondary air gaps.

5 - A bidirectional actuator according to at least one of the preceding claims, characterized in that the ratio L/E of the thickness L of the magnet and the thickness E of the air gap ranges between 1 and 2.

6 - A bidirectional actuator according to at least one of the

preceding claims, characterized in that the dimensions of the secondary air gaps are $C_1 + E$ and $C_2 + E$, where C_1 and C_2 denote the travel range of the movable magnet in the two directions of the secondary air gaps and in that the dimensions of the magnet are $C_1 + d_1 + E$ and $C_2 + d_2 + E$, where d_1 and d_2 denote the widths of the secondary air gaps.

7 - A bidirectional actuator according to claim 1 or 2, characterized in that the stator structure is composed of two stator pieces disposed one on one side and one on the other of the magnet, each stator piece having a pair of stator poles, the pair of stator poles of one of the pieces being oriented perpendicular to the pair of stator poles of the other stator piece.

8 - A bidirectional actuator according to claim 1 or 2, characterized in that the magnet has tubular shape and is movable, in a first degree of freedom, by axial translation and, in a second degree of freedom, by axial rotation relative to a stator structure formed from 4 stator poles in the form of cylinder portions, provided with a first secondary air gap in the longitudinal central plane, in which there is placed a first electric coil wound around at least one ferromagnetic core, and with a second secondary air gap in the transverse plane, in which there is placed a second electric coil wound around a ferromagnetic core.

9 - A bidirectional actuator according to claim 1 or 2, characterized in that the magnet has tubular shape and is movable, in a first degree of freedom, by axial translation and, in a second degree of freedom, by axial rotation relative to an external cylindrical stator structure formed from 4 stator poles having a concave surface defining the primary air gap with the cylindrical yoke placed inside the magnet, each of the four stator poles being

wound by an electric coil.

10 - A bidirectional actuator according to claim 1 or 2, characterized in that the magnet has tubular shape and is movable, in a first degree of freedom, by axial translation and, in a second degree of freedom, by axial rotation relative to a cylindrical stator structure comprising a first external stator piece for displacement in a first degree of freedom and a second internal stator piece for displacement in a second degree of freedom, each of the stator pieces having at least one electric exciting coil.

11 - A bidirectional actuator according to claim 1 or 2, characterized in that the magnet has spherical shape and is movable in spherical rotation relative to a stator structure in the form of a spherical cup formed from 4 stator poles in the form of cup sectors provided with two coils located in peripheral grooves whose central planes are perpendicular.

12 - A bidirectional actuator according to claim 1 or 2, characterized in that the magnet has spherical shape and is movable in spherical rotation relative to a stator structure of tubular shape formed from 4 stator poles in the form of tube quarters, wound by an electric coil.

13 - A bidirectional actuator according to claim 11, characterized in that the primary air gap has spherical shape.

14 - A bidirectional actuator according to claim 1 or 2, characterized in that the magnet has spherical shape and is enclosed by a spherical cup, and is movable in spherical rotation around a stator structure of spherical or hemispherical shape formed from 4 stator poles in the form of sphere quarters or eighths.

15 - A bidirectional actuator according to claim 1 or 2, characterized in that the magnet has spherical shape and is enclosed by a cup formed from two pieces in the form of hemispheres or sphere quarters, and is movable in spherical rotation around a stator structure formed from two hemispherical stator pieces.

16 - A bidirectional actuator according to at least one of the preceding claims, characterized in that each of the pairs of poles (1, 2), (3, 4) defines between two adjacent poles a secondary air gap, and in that it contains a sensor which is sensitive to magnetic fields and which is located in the said secondary air gap.